MODIS Cloud Property Retrievals

Bryan A. Baum

Collaborators

NASA LaRC: Yong Hu, Dave Kratz

CIMSS: Paul Menzel, Steve Ackerman, Jeff Key, Shaima Nasiri, Rich Frey, Chris Moeller, Liam Gumley, Mat Gunshor

NCAR: Andy Heymsfield, Greg McFarquhar

NASA GSFC: Michael King, Ping Yang, Steve Platnick

UCLA: Kuo-Nan Liou, Philippe Rolland

U. Alabama- Huntsville: Ron Welch, Todd Berendes (IVICS rocks for data exploration!)

Topics:

Basic features of MODIS

Preliminary results

Areas of emphasis

Pertinent MODIS Information

Information on MODIS calibration, technical specifications, and data products, can be found at the MODIS Web site:

http://modis.gsfc.nasa.gov

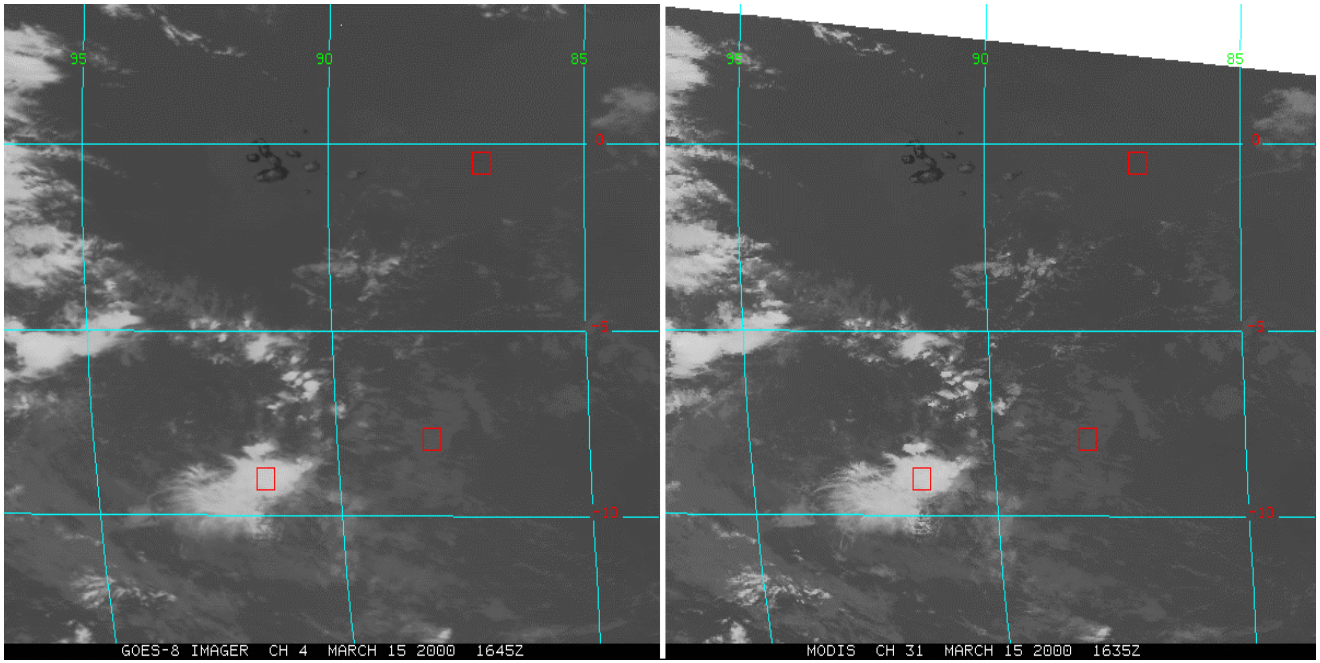
Known concerns/problems in the MODIS Level 1B data stream can be found at the MODIS Characterization Support Team (MCST) site:

http://mcstweb.gsfc.nasa.gov

For information on the MODIS Atmospheres Team:

http://modis-atmos.gsfc.nasa.gov

Comparison of MODIS and GOES 11-μm Radiances



Courtesy of Mat Gunshor

CIMSS/UW-Madison

Lat/Lon	Satellite	Pixels	Minimum	Maximum	Mean	Stn. Dev.
-9.0 / 91.5 (Cold)	GOES-8 Ch 4	289	20.525 = 218.16 K	26.645 = 227.80 K	22.161 = 220.91 K	2.063
	MODIS Ch 31	289	20.310 = 214.61 K	32.355 = 232.35 K	23.465 = 219.82 K	1.309
-7.9 / 88.1	GOES-8 Ch 4	289	88.613 = 285.73 K	97.602 = 291.66 K	91.851 = 287.90 K	1.335
	MODIS Ch 31	289	93.888 = 286.25 K	104.145 = 292.84 K	97.859 = 288.85 K	1.853
-0.5 / 87.0 (Warm)	GOES-8 Ch 4	289	100.280 = 293.64 K	101.519 = 294.21 K	100.999 = 293.82 K	0.292
	MODIS Ch 31	289	105.445 = 293.6433 K	106.228 = 294.13 K	105.836 = 293.89 K	0.138

First MODIS Images

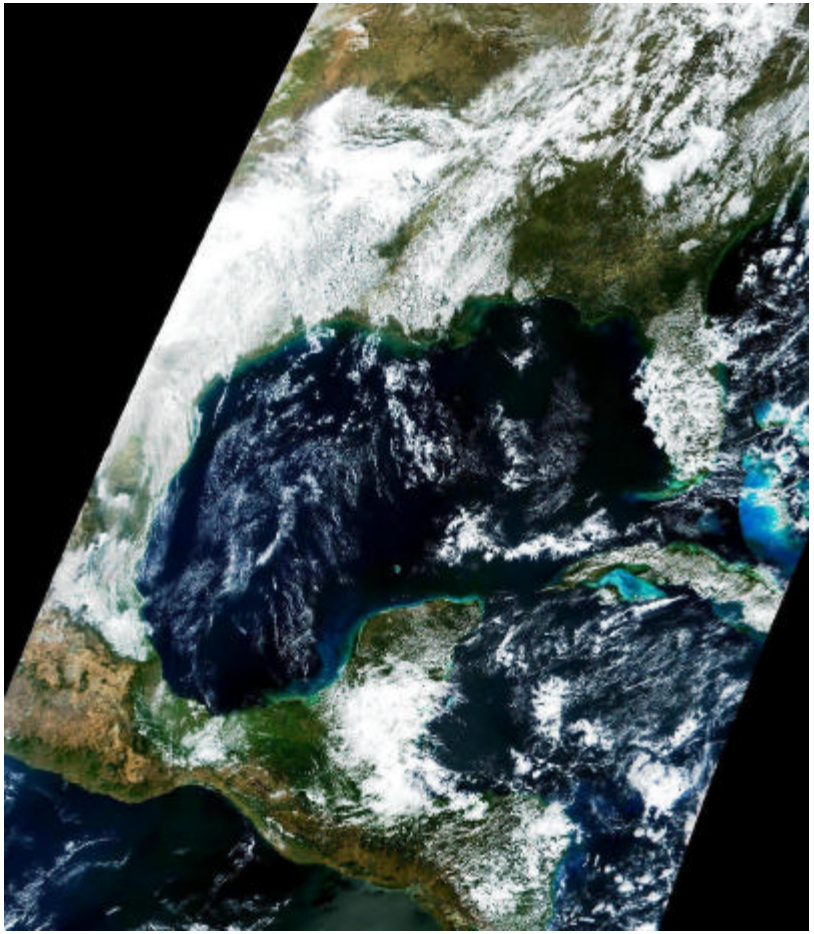
A MODIS image gallery is available at the MODIS Web site:
http://modis.gsfc.nasa.gov

The following images are courtesy of Michael D. King.

MODIS First Image - Gulf of Mexico

February 24, 2000

- **Yucatan Peninsula, Gulf of Mexico, western Caribbean Sea, and southeastern US**
  - **Clouds are represented in white**
  - **Ocean coastal features & sediment flows are visible**
  - **Shallow water in Caribbean shows up as bright azure**
- **Image swath**
  - **2300 km wide by ~3200 km long**
- **True color composite**
  - **0.645 µm (red), 0.555 µm (green), and 0.469 µm (blue)**



Mississippi River Delta

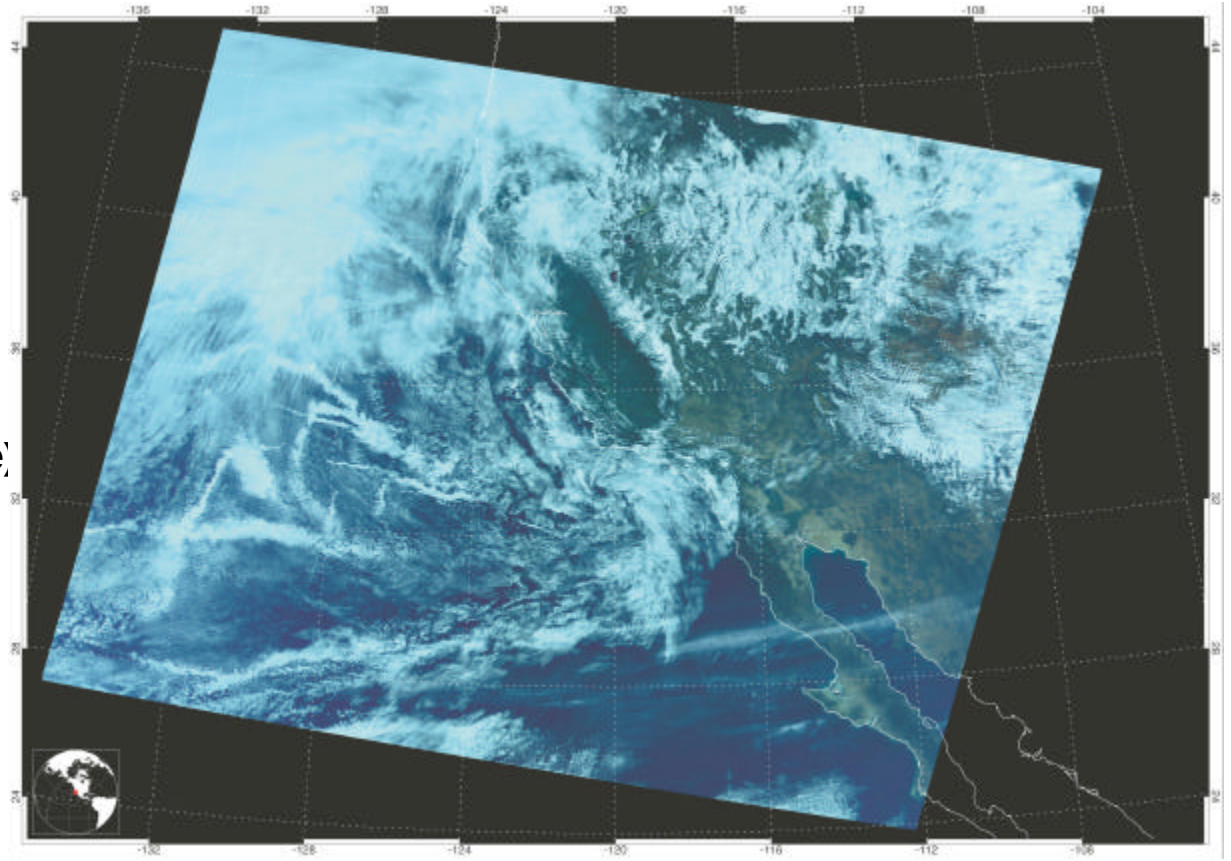
February 24, 2000

- **Subset of MODIS first image**
- **Mississippi Delta region from Louisiana to Mississippi**
  - **Sediment plume associated with Mississippi River discharge**
  - **Barrier Islands**
- **Image swath**
  - **250 km wide by 250 km long**
- **True color composite**
  - **0.645 µm (red), 0.555 µm (green), and 0.469 µm (blue)**

Ship Tracks off California

February 25, 2000

- **Image swath**
  - **2300 km wide**
  - **2166 km long**
- **True color composite**
  - **0.645 µm (red)**
  - **0.555 µm (green)**
  - **0.469 µm (blue)**

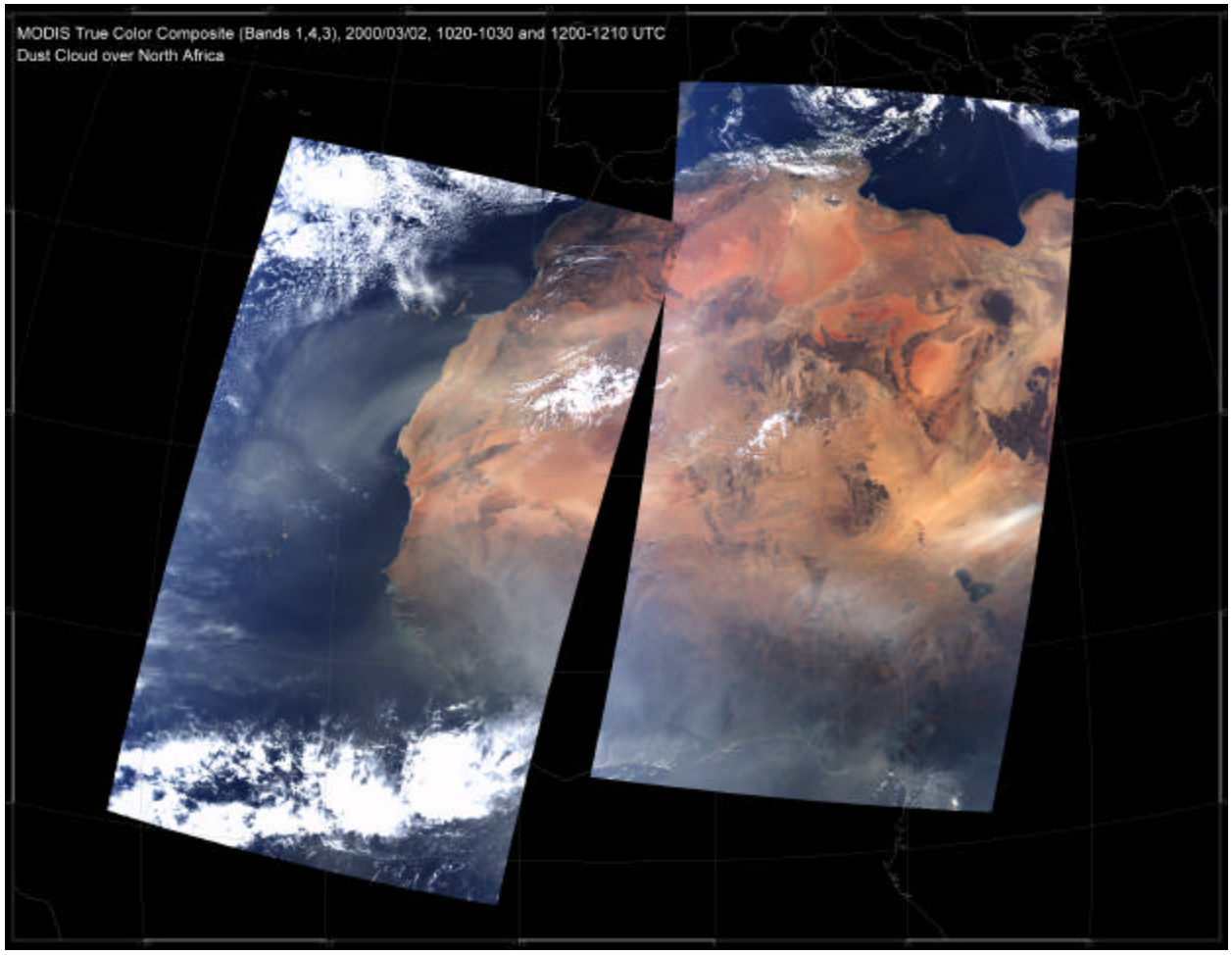


Dust Cloud over North Africa

March 2, 2000

1020-1030 UTC
1200-1210 UTC

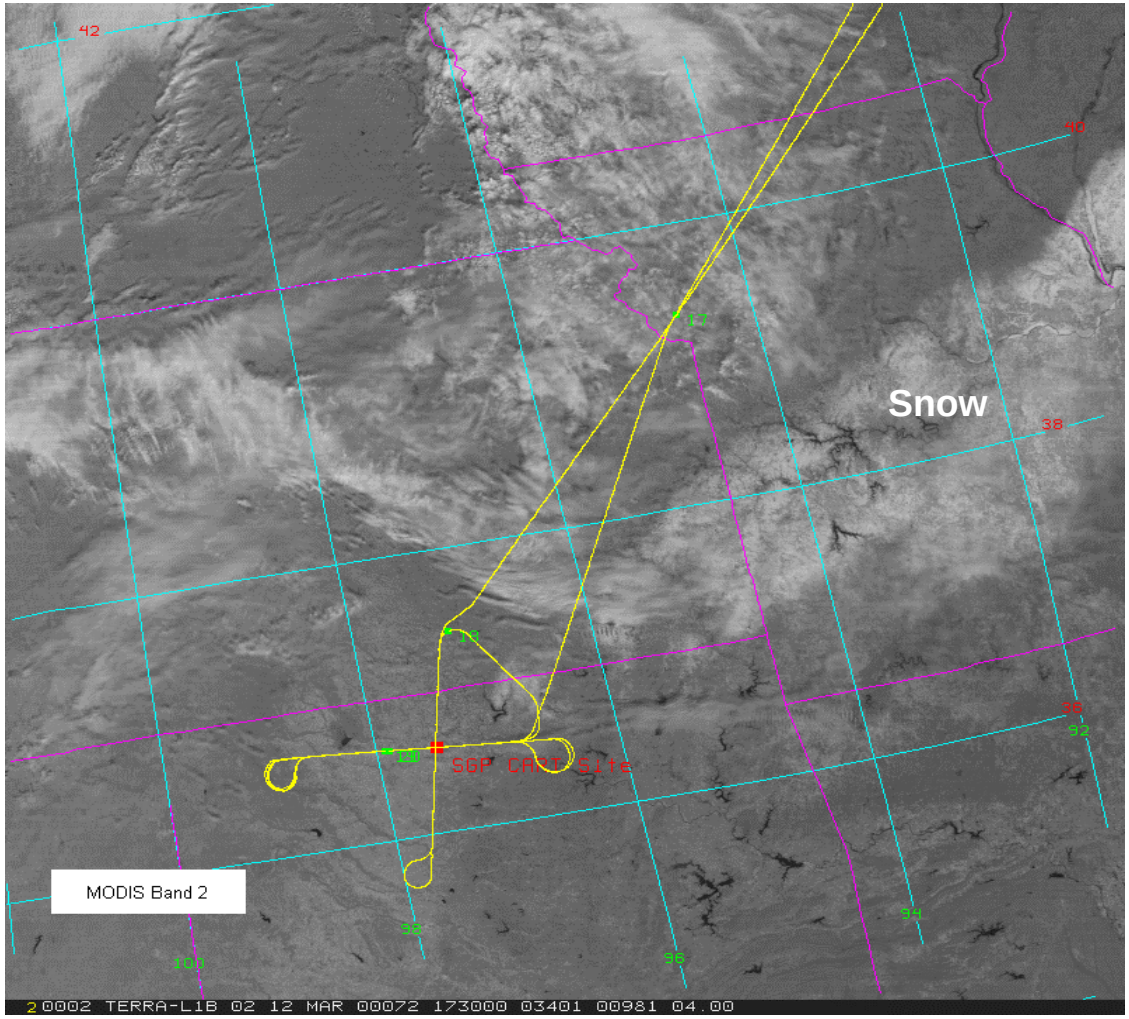
R = 0.645 µm
G = 0.555 µm
B = 0.469 µm



Preliminary Results

NOTE: calibration changes are occurring frequently; these results show work in progress

MODIS Cloud Analysis Study on March 12, 2000 During ARM IOP

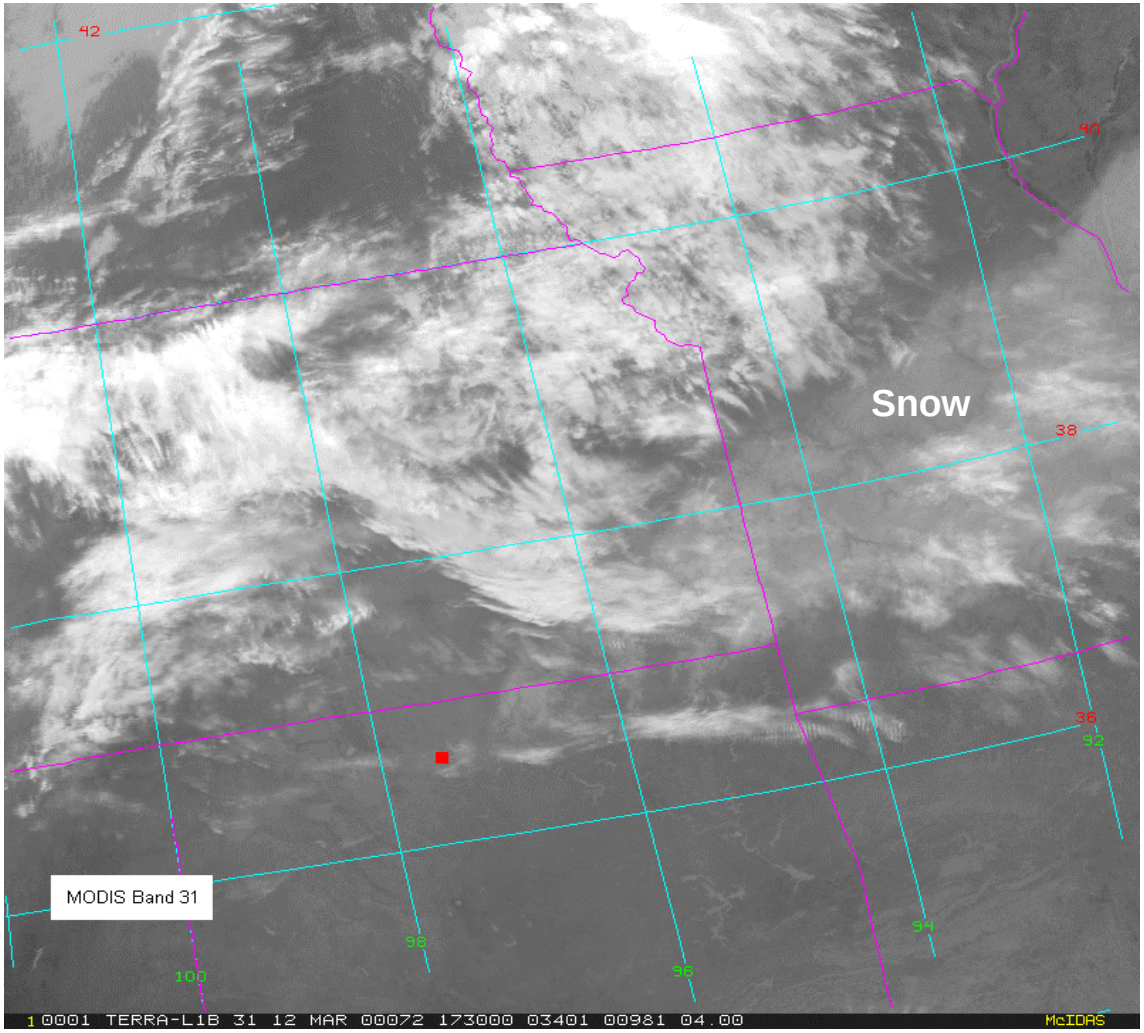


MODIS Band 2

0.86 mm

ER-2 Flight Track shown in yellow

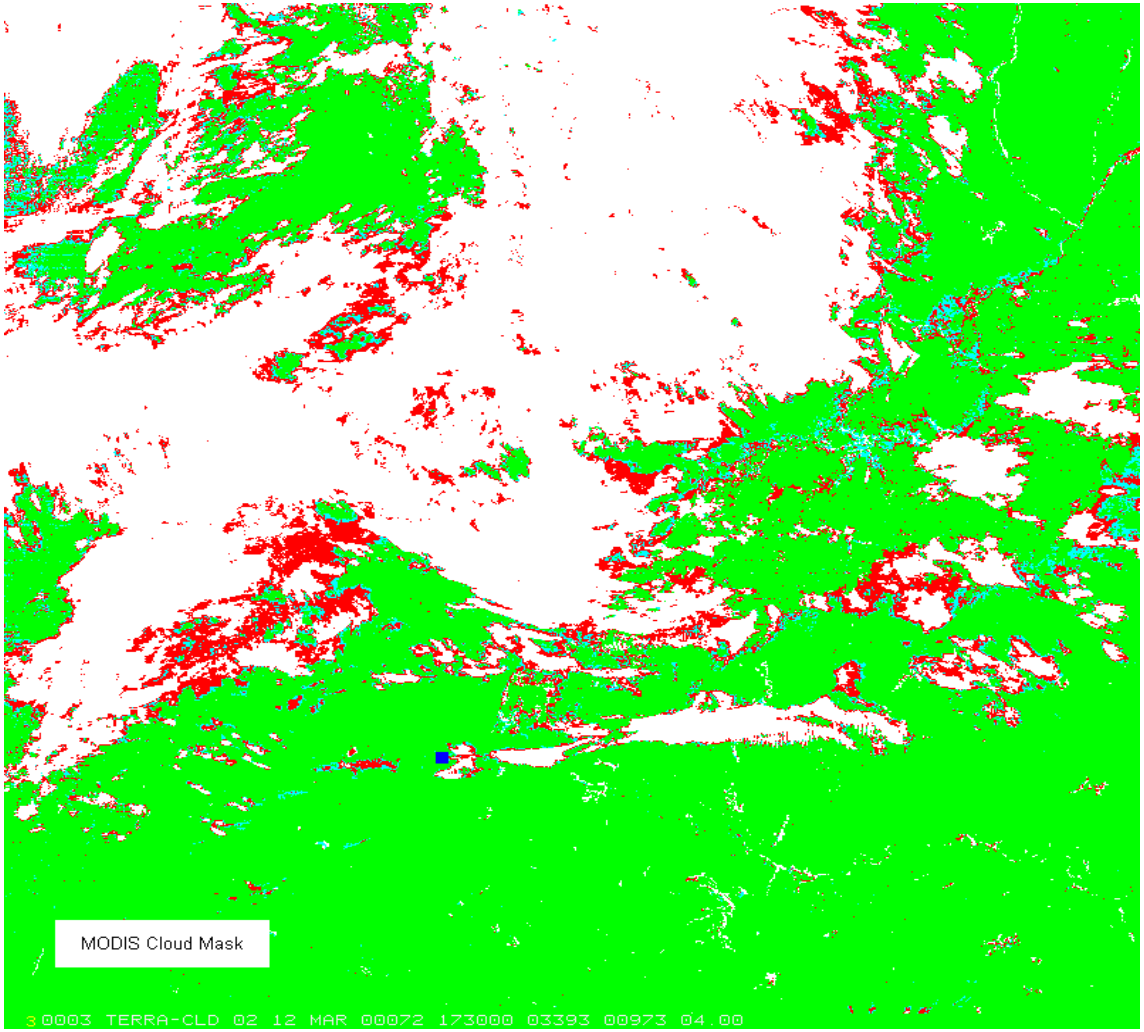
MODIS Cloud Analysis Study on March 12, 2000 During ARM IOP



MODIS Band 31

11 mm

MODIS Cloud Clearing Analysis



Green: Confident clear

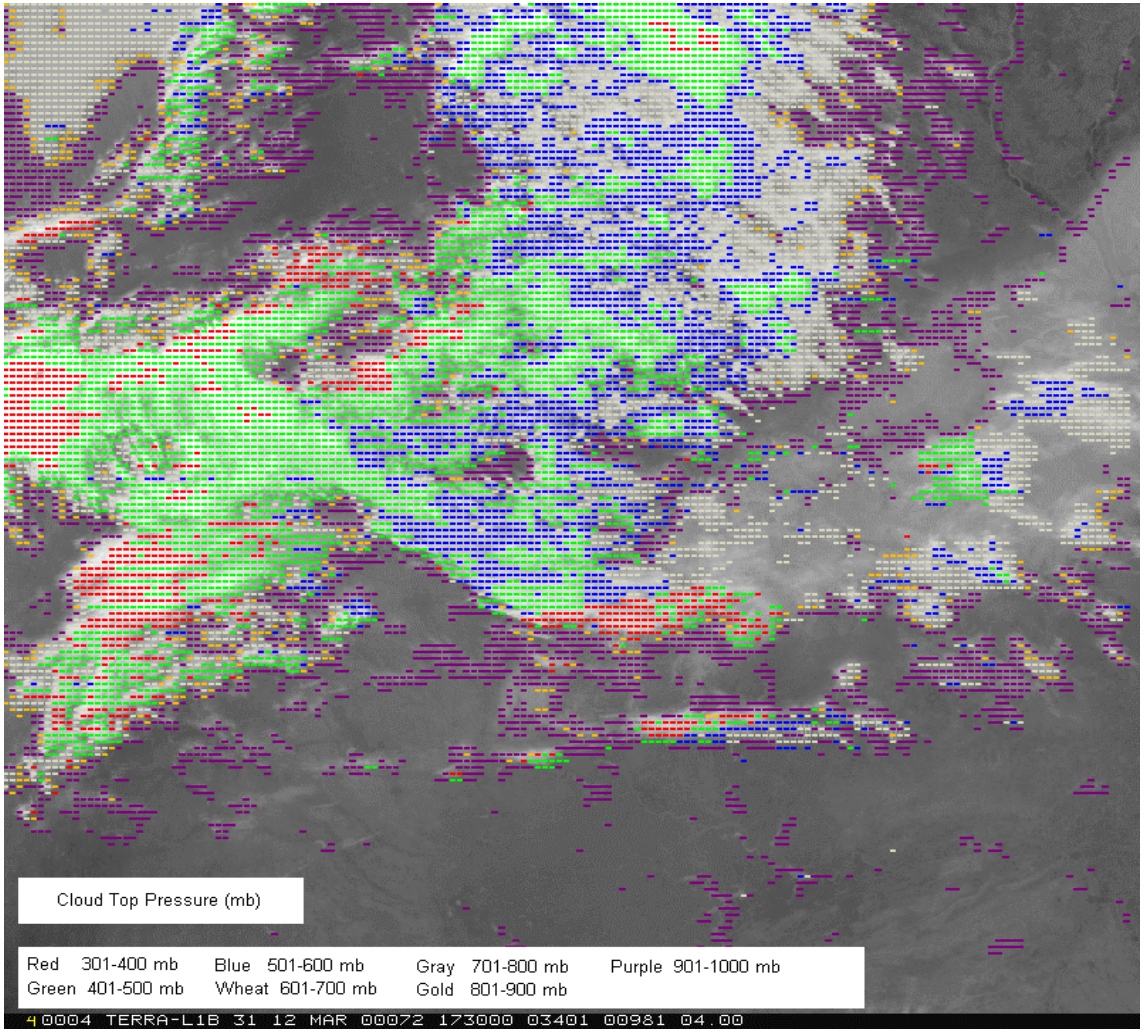
Blue: Less confident clear

Red: uncertain

White: confident cloud

courtesy of Rich Frey CIMSS/UW-Madison

MODIS Cloud Height Retrievals



Red: 301-400 mb

Green: 401-500 mb

Blue: 501-600 mb

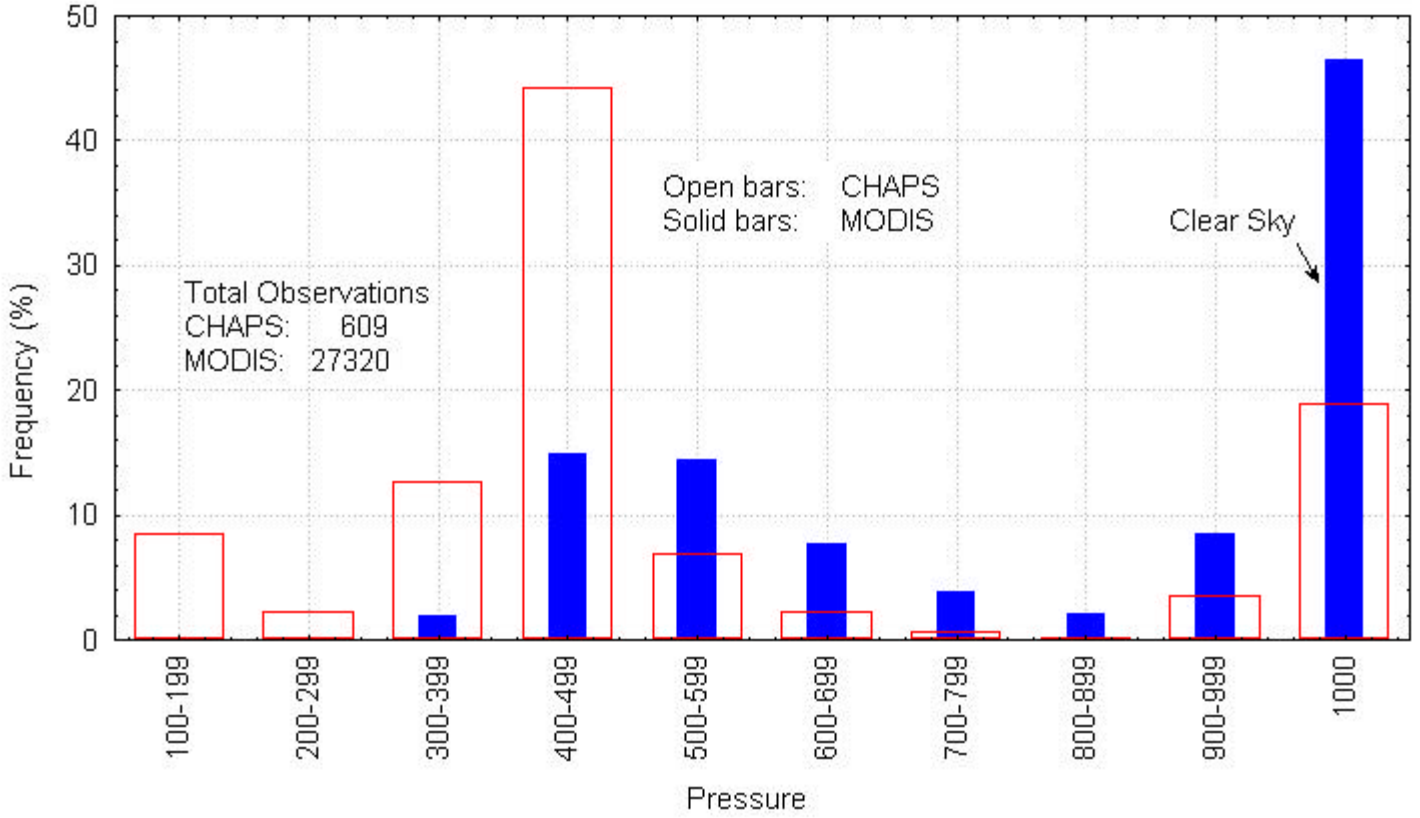
Wheat: 601-700 mb

Gray: 701-800 mb

Gold: 801-900 mb

Purple: 901+ mb

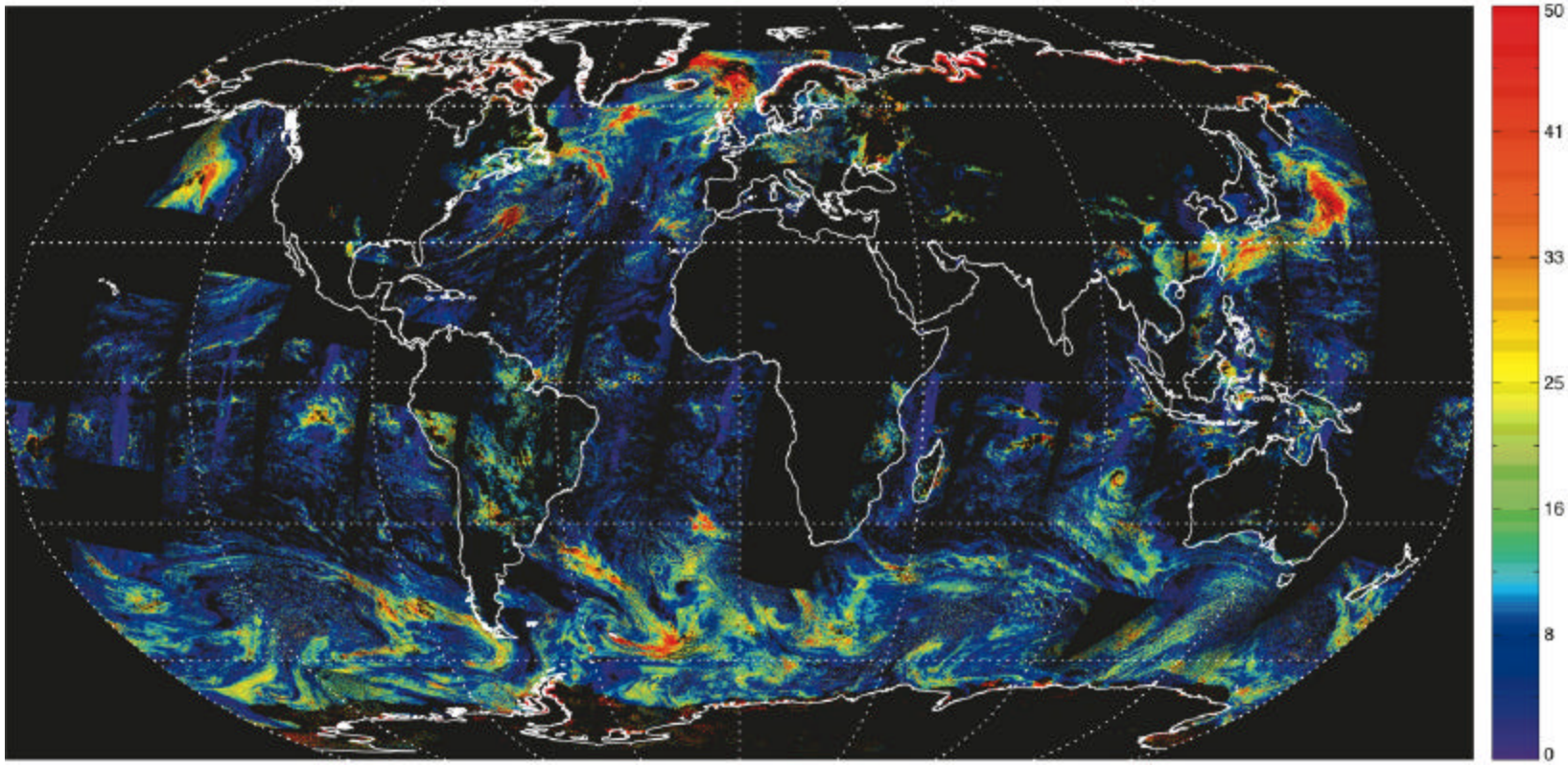
courtesy of Rich Frey
CIMSS/UW-Madison


MODIS and CHAPS CO_2-slicing Cloud Top Pressures
March 12, 2000
36-40 North Latitude and 90-100 West Longitude
Frequency (%)
50
40
30
20
10
0
Open bars: CHAPS
Solid bars: MODIS
Clear Sky
Total Observations
CHAPS: 609
MODIS: 27320
100-199
200-299
300-399
400-499
500-599
600-699
700-799
800-899
900-999
1000
Pressure

Global Cloud Optical Thickness

March 5, 2000

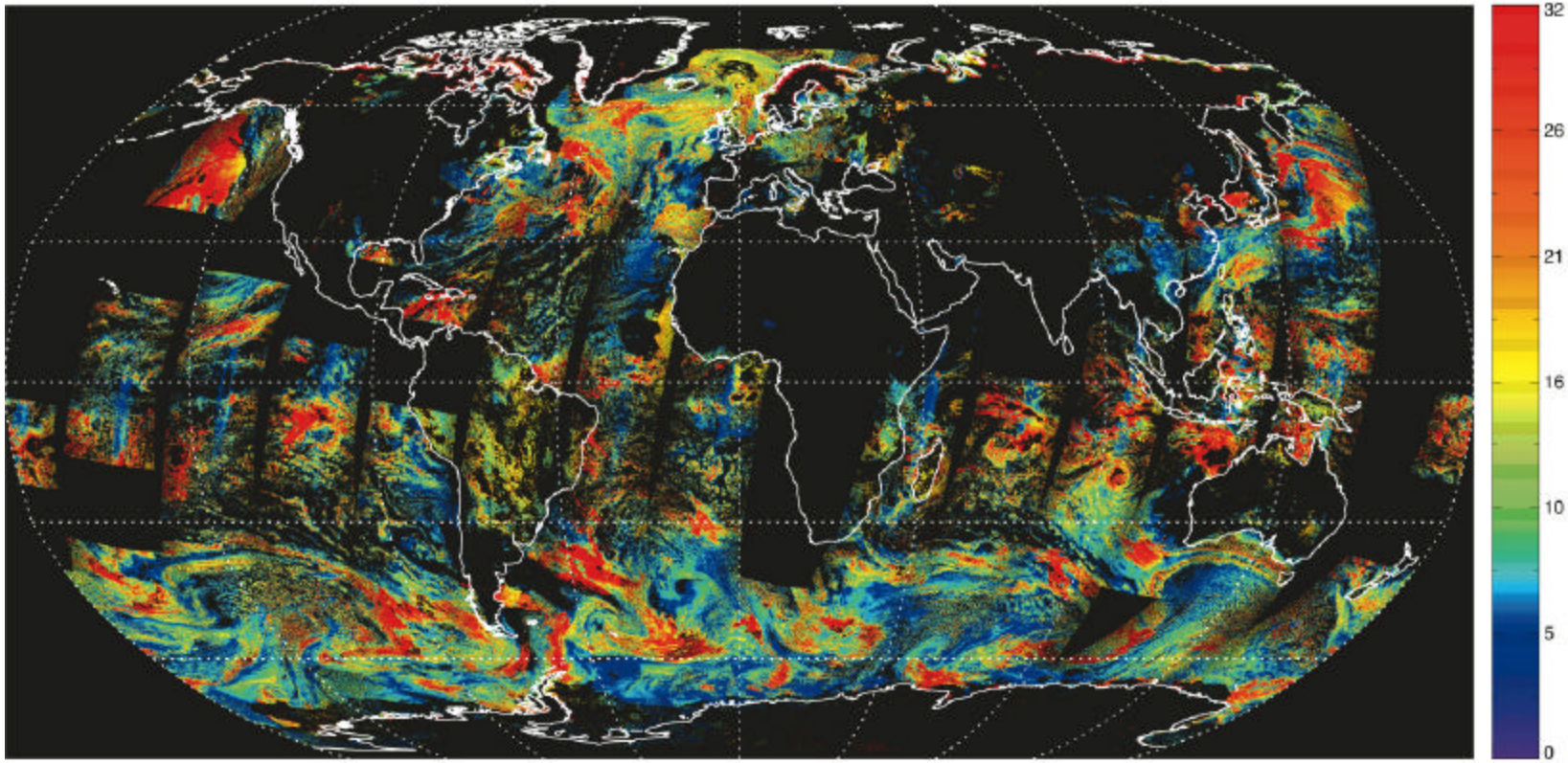
- **Water Clouds**



Global Cloud Effective Radius

March 5, 2000

- **Water Clouds**



Data Product Validation/Comparison

Cloud Clearing

Variety of approaches (use of MAS/CLS on the ER-2, surface observers, ARM CART site data products, feedback from ocean & land groups)

Cloud Height

- Comparison of GOES hourly cloud height results with MODIS (CO_2 slicing). For more info, see Tony Schreiner's web site: http://cimss.ssec.wisc.edu/goes/goes.html and click on "realtime."
- Comparison of MODIS to ARM CART site cloud products
- Comparison of regional and zonal cirrus cloud statistics derived from HIRS, CHAPS (Combined HIRS and AVHRR Products), GOES, and MODIS

Data Product Validation/Comparison

Cloud Thermodynamic Phase

• Comparison of MODIS trispectral/multispectral methods to measurements from polarization lidars such as the High Spectral Resolution Lidar (HSRL)

• Ed Eloranta's Web site: http://lidar.ssec.wisc.edu

Cloud Layering

• Continue to design/code/implement/test/validate methods to detect and analyze regions where thin cirrus overlies lower-level clouds.

• Building bridges between MODIS and ARM CART site investigators.

• Want to have methodology in place before PICASSO and CLOUDSAT launch.

Summary

The MODIS Atmospheres Group is actively

- pursuing sensor calibration activities,
- involved with field experiments,
- building bridges with validation groups, e.g. ARM,
- fixing the myriad sorts of coding problems that you expect in the startup phase of global data processing,
- reacting to feedback from the land and ocean groups, and
- having a whole lot of fun looking at the data!